December 6, 1877.

Sir JOSEPH HOOKER, C.B., President, in the Chair.

The President announced that he had appointed as Vice-Presidents :—

The Treasurer.
Mr. Abel.
Dr. Farr.
Prof. Henry Smith.
Dr. Allen Thomson.

The Presents received were laid on the table, and thanks ordered for them.

The following Papers were read :—

I. "On the Tides at Malta." By Sir G. B. Airy, K.C.B., Astronomer Royal. Received July 14, 1877.

(Abstract.)

A self-registering tide-gauge had been erected in the harbour of La Valetta, and records had been made with it continuously from 1871, March 31, to April 28, and with interruptions through other days, under the care of Admiral Sir Cooper Key, Naval Commander at Malta; and the register sheets were placed in the hands of the Astronomer Royal. They form a band about 60 feet long.

The first step required to make the observations available was to eliminate the effects of frequent non-tidal undulations, whose period is approximately 21^m. This was done by carefully bisecting the intervals between adjacent elevations and depressions in about 1100 instances, and drawing a pencilled curve through the points of bisection.

It then became necessary to consider the best plan of reduction. It was determined to commence by comparison, in respect of times, with the predicted tides at London, as given in the Admiralty Tide-Tables, which are generally recognized as accurate, and are free from diurnal tide. The times of London high-water were therefore laid down on the register-sheets (without regard to difference of longitude); each tidal day was divided into 48 equal parts, and for each dividing point the ordinate of the tidal curve was measured. The number of measures is about 1900. These measures were collected in groups of 6 measures for each group (or 8 groups for each tidal day), and the mean of each group is exhibited in a Table.

The method of treating these means of group-measures is then ex-

plained. The object is to express every height on each separate day by the following formulæ, in which θ is the tidal angle, increasing from 0 at the beginning to 2π, or 24^h, at the end of the tidal day:—

For mean height, M;
For semidiurnal tide, $P \cdot \sin 2\theta + Q \cdot \cos 2\theta$;
For diurnal tide, $p \cdot \sin \theta + q \cdot \cos \theta$.

The mathematical process is investigated, and an easy practical rule is found for its application. Thus the numerical values of M, P, Q, p, q are found for every day. The two tidal expressions are without difficulty converted into the following—

Half semidiurnal range × cosine of (2θ − 2 retard of semidiurnal high-water on the zero of tidal time),

Half diurnal range × cosine of (θ—retard of diurnal high-water on the zero of tidal time),

By the formulæ,

Half-range $= \sqrt{(P^2+Q^2)}$ or $= \sqrt{(p^2+q^2)}$ for the two tides respectively,

Tan 2 retard for semidiurnal tide $= \frac{P}{Q}$,

Tan retard for diurnal tide $= \frac{p}{q}$.

Thus the retard of each tide on the zero of tidal time is found for every day. The adopted zero of tidal time, for a reason given in the paper, is 16^m earlier than the tabular time of London high-water: and thus the real time of each of the Malta high waters for every day is found. This is then compared with the time of moon's transit in the Nautical Almanac; and thus the retard of each high water on the moon's transit is found. For more distinct view of the changes the lunation is divided into eight equal parts, and the means of the several classes of results are taken for each eighth part, by a process explained in the paper.

The following are the principal results:—

1. The value of M, the mean height for each day, has a regular and well-defined luni-menstrual change connected with the moon's declination. It is suggested that, viewing the extreme slowness of the change, it is probable that this inequality differs little in magnitude and epoch from the corresponding inequality on the oceanic shores of Spain and Morocco, and that perhaps it gives the best measure of that inequality.

2. The semimenstrual inequality in time of the semidiurnal tides is very well marked. In magnitude it is sensibly the same as that at London, but its epoch is about three days earlier.

3. The semimenstrual inequality in height of the semidiurnal tides is also very well marked. Its epoch is earlier than that for London by about three days; but the proportion of its coefficient in height to the coefficient of semidiurnal tide in height is greater than at London.

(It is curious that these results should be deduced with such certainty

and accuracy from tides in which the greatest single coefficient is $3\frac{3}{4}$ inches.)

4. The mean retard of semidiurnal high water on the moon's transit is about $16^h\ 4^m$, which may be taken as the establishment at Malta.

5. The results for the diurnal tides (whose coefficient in the mean is about 0·3 inch) are somewhat discordant, but appear to exhibit a periodical law of coefficients, such as is proper for them.

The last point for examination is, the character of the non-tidal undulations already mentioned. These, in many cases, far exceed the tidal oscillations. Similar undulations at Swansea had attracted attention many years ago ('Encyclopædia Metropolitana,' "Tides and Waves"; and private correspondence with J. W. G. Gutch, Esq.). Lately, however, the undulations of the same character in the Swiss lakes, called *Seiches*, have been carefully examined by Dr. Forel; and there appears to be no room for doubt that the non-tidal oscillations at Malta are genuine *Seiches*. They appear to be formed by waves reflected from opposite shores, producing stationary waves between them. The shores concerned in forming the *Seiches* of Malta seem to be those of Africa and Sicily. A Table, exhibiting the principal elements of their intervals and their magnitudes, is given in the paper.

II. "Observations on Hermetically-sealed Flasks opened on the Alps." In a Letter to Professor Huxley, Sec. R.S. By Professor Tyndall, LL.D., F.R.S. Received September 21, 1877.

Alp Lusgen, 18th September, 1877.

My Dear Huxley,—Though the question of "Spontaneous Generation" is, I believe, practically set at rest for the scientific world, you may possibly deem the following facts of sufficient interest to be communicated to the Royal Society.

I brought with me this year to the Alps sixty hermetically-sealed flasks, containing infusions of beef, mutton, turnip, and cucumber, which had been boiled for five minutes in London and sealed during ebullition. They were packed in sawdust, and when opened at the Bel-alp the drawn-out and sealed ends of six of them were found broken off. These six flasks were filled with organisms, the remaining ones were pellucid and free from life.

Two or three of them were subsequently broken by accident, but for six weeks fifty of the flasks remained perfectly clear.

At the end of this time I took twenty-three of them into a shed containing some fresh hay, and there snipped off their sealed ends with a pair of pliers. The air of the hay-loft entered to fill the vacuum produced by the boiling in London. Twenty-seven other flasks were taken immediately afterwards to the edge of a declivity, which might almost be